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MICROGRAVITY SCIENCE GLOVEBOX (MSG)

INTERFACE CONTROL DOCUMENT

FOR

SOLIDIFICATION USING A BAFFLE IN SEALED AMPOULES (SUBSA)

SYSTEMS ENGINEERING OFFICE / SD42

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June 4, 2001

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(SUBSA)**

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TABLE OF CONTENTS

<u>PARAGRAPH</u>	<u>PAGE</u>
<u>TABLE OF CONTENTS</u>	i
<u>LIST OF TABLES</u>	ii
<u>LIST OF FIGURES</u>	ii
<u>APPENDIXES</u>	iii
1.0 SCOPE.....	1
1.1 Use.....	1
1.2 Experiment Description.....	2
2.0 APPLICABLE DOCUMENTS.....	3
2.1 Acronyms.....	3
3.0 INVESTIGATION INTERFACE AND RESOURCE ALLOCATIONS.....	4
3.1 Mechanical Interfaces and Resource Allocations	4
3.1.1 Stowage Resource Allocation.....	4
3.1.2 Hardware Responsibility.....	4
3.1.3 Structural/Mechanical Interface.....	13
3.1.3.1 SUBSA.....	13
3.2 Electrical Interfaces.....	15
3.2.1 Electrical Power Interfaces.....	15
3.2.2 Cabling Interfaces.....	15
3.2.3 Grounding/Isolation.....	15
3.2.4 Bonding.....	15
3.2.5 Power Resource Allocation.....	18
3.3 C&DH Interfaces.....	20
3.3.1 Data downlink Requirements.....	20
3.3.2 Uplink Requirements.....	20
3.3.3 Post Mission Data Requirements.....	20
3.4 Thermal Control Interface Allocations.....	23
3.4.1 Ascent/Descent.....	23
3.4.2 On-Orbit Thermal Characteristics.....	23
3.5 Vacuum System Requirement.....	23
3.5.1 Vacuum Exhaust System.....	23
3.5.2 Vacuum Resource System.....	23
3.6 Pressurized Gas Requirement.....	23
3.6.1 GN2 requirement.....	23
3.6.2 Pressurized Gas Bottles.....	23
3.7 Special Environment.....	24
3.7.1 Vibration.....	24
3.7.2 Stowage.....	24
3.8 KSC Requirements.....	25

4.0 INVESTIGATION VERIFICATION.....	28
4.1 Purpose.....	28
4.2 Verification Applicability Matrix.....	28

LIST OF FIGURES

<u>FIGURE</u>	<u>PAGE</u>
1 SUBSA COHU CAMERA and CAMERA STAGE ASSEMBLY...	9
2 SUBSA THERMAL CHAMBER.....	10
3 SUBSA PCM.....	11
4 SUBSA DAQPAD.....	12
5 SUBSA SAMPLE CONTAINER.....	13
6 SUBSA MOUNTING PROVISIONS.....	14
7 SUBSA ELECTRICAL/SIGNAL INTERFACE BLOCK DIAGRAM	16
8 SUBSA POWER PROFILE.....	19

LIST OF TABLES

<u>TABLE</u>	<u>PAGE</u>
I SUBSA SUPPLIED HARDWARE.....	5
II MSG SUPPLIED OUTFITTING EQUIPMENT.....	6
III LAB SUPPORT EQUIPMENT.....	8
IV MICROGRAVITY MEASUREMENT EQUIPMENT	8
V SUBSA TO MSG PRIMARY POWER INTERFACE PIN FUNCTIONS.	17
VI SUBSA TO MSG SECONDARY POWER INTERFACE PIN..... FUNCTIONS	17
VII SUBSA POWER ALLOCATION (WATTS).....	18
VIII SUBSA TO MSG SIGNAL CABLE PIN FUNCTIONS.....	21
IX SUBSA TO MSG VIDEO CONNECTOR PIN FUNCTIONS.....	22
X ENVIRONMENTAL CONTROL REQUIREMENTS.....	24
XI SUBSA THERMAL ACCOMMODATIONS.....	24
XII INVESTIGATION SUPPORT REQUIREMENTS.....	25
XIII EQUIPMENT SUPPORT REQUIREMENTS.....	26
XIV CHEMICAL SUPPORT REQUIREMENTS.....	26
XV REUSABLE AND EXPENDABLE SUPPLY SUPPORT	26
REQUIREMENTS	
XVI GENERAL SERVICES SUPPORT REQUIREMENTS.....	27
XVII KSC TECHNICAL REQUIREMENTS.....	27
XVIII SUBSA VERIFICATION MATRIX.....	36

APPENDIXS

<u>APPENDIX</u>	<u>PAGE</u>
A ACRONYMS.....	31
B SUBSA VERIFICATION MATRIX.....	35

MSFC-ICD-3086A

June 4, 2001

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1.0 SCOPE

This Interface Control Document (ICD) is the exclusive document that establishes the agreements between the Investigation Developer (ID) and the Microgravity Science Glovebox (MSG) Investigation Integration Team (IIT). The ICD identifies and establishes the SUBSA investigation's physical/functional interfaces with the MSG facility. The SUBSA interfaces and design must conform to the requirements and guidelines of the MSG Investigation Interface Requirements Document (IIRD), MSFC-RQMT-2888. This document contains the interface and resources allocated to SUBSA for the performance of their science. Both sides of the interface are shown, and includes mechanical, structural, electrical, avionics, environment, and functional interfaces. This document is under the control of the Microgravity Science Glovebox Integration (MSGI) Level III Configuration Control Board, and any changes or revisions shall be approved by the MSG Integration Manager (IM).

This ICD is the primary source for design implementation and documenting MSG specific interfaces of the MSG Investigation Interface Requirements Document, MSFC-RQMT-2888. This ICD controls the interfaces between the SUBSA investigation, the MSG and other elements and systems of the International Space Station (ISS). The ICD also contains the ground handling/integration requirements the SUBSA investigation needs during ground processing at KSC.

This ICD identifies and controls the following:

- Resources allocated to SUBSA.
- Physical interfaces between SUBSA to the MSG.
- KSC Integration Requirements
- Verification

1.1 Use. Section 3 of this document contains the SUBSA specific interface information and ground handling requirements. Section 4 describes the verification activities and has an applicability matrix that provides traceability back to the specific interface design requirements contained in the MSG IIRD, MSFC-RQMT-2888 which are applicable to SUBSA. The specific verification methods for each IIRD interface design are contained in the Investigation Applicability Matrix. SUBSA is responsible for providing the specific Investigation interface information in Section 3 for each applicable

interface as well as identifying all applicable IIRD requirements in MSFC-RQMT-2888. Any deviations/exceptions to the requirements must be approved by the MSG IIT. SUBSA will be responsible for providing any analysis or documentation required to evaluate and disposition the identified exception to the IIRD.

1.2 Experiment Description. Solidification Using a Baffle in Sealed

Ampoules (SUBSA) will provide insight to understanding the use of a baffle during directional solidification to minimize natural convection in the melt. The baffle should significantly reduce the maximum temperature difference and the characteristic size of the melt. In microgravity, the baffle should reduce convection driven by residual acceleration, which is particularly harmful when acting normally to the axis of the ampoule. The material proposed for this investigation is Indium-Antimonide (InSb). In addition to the technology demonstration, the following scientific data will be obtained:

- a. An investigation of the behavior and possible advantages of liquid encapsulation.
- b. Data on two-fluid behavior in microgravity
- c. Growth without dewetting of Te-doped InSb; diffusion controlled solidification may be obtained.

The SUBSA investigation consists of the following hardware:

A thermal chamber containing an interchangeable sample system, one temperature-controlled hot zone, and a gradient zone. The thermal chamber will be mounted to the coldplate. One video camera is mounted to give front-side viewing of the gradient zone during processing.

The Data Acquisition Pad (DaqPad) provides data acquisition and signal conditioning functions for the sample temperature probes. It communicates with the MSG Laptop Computer (MLC) via the parallel port interface. The DaqPad is located inside the MSG WV and is attached to the bottom of the PCM. The DaqPad acquires the sample temperature readings while the MLC records the values to the hard drive and routes the data to the Process Control Module for overlay on the camera image.

The Process Control Module (PCM) maintains the thermal chamber heater setpoints, overlays text and thermal data onto the video camera images, and routes the modified images via video cable connections to the MSG video subsystem. The MSG downlinks the video images to the ground during acquisition of signal while the VCRs simultaneously record the images to tape on board the ISS. The PCM receives the sample temperature data from the MLC via the RS232 serial link. The firmware

temperature controller units receive remote setpoint adjustment via RS232 serial link to the MLC. The PCM is mounted via threaded fasteners to the top right corner of the MSG WV.

The SUBSA samples consist of a cylindrical quartz tube with an outside diameter of 16.0 mm and have an approximate length of 31 cm. The inside diameter varies from 12 mm in the sample processing region to 13mm where the graphite baffle guide sleeve is located. The sample material will be InSb with dopants to be selected by the GI. Ten SUBSA transparent sample assemblies are requested for the UF-2 mission, with two spare samples available as replacements.

SUBSA will also utilize the MSG's video monitors and MLC. Both items will be located outside MSG's work volume in the crew cabin.

2.0 APPLICABLE DOCUMENTS

The MSG Project Office provides the reference documents cited in this document. The specified technical requirements listed in the body of this document must be met whether or not the source document is listed in this section. Unless otherwise specified, the referenced document latest revision level applies.

MSFC-RQMT-2888 MSG Investigation Interface Requirement
 Document

2.1 Acronyms. See Appendix A for acronyms list.

3.0 INVESTIGATION INTERFACES AND RESOURCE ALLOCATIONS

3.1 Mechanical Interfaces and Stowage Resource Allocation. This section defines the structural interfaces the investigation requires while operating inside the MSG and the stowage resources and support equipment required for on-orbit operations and launch.

3.1.1 Stowage Resource Allocation. The total control mass allocation for the SUBSA hardware is 81.5 lbs. (37 kg.). The total control volume allocation for the SUBSA hardware is 0.140 m³. The SUBSA samples will be loaded into the MPLM at L-88 hours. The stowage items for SUBSA are listed in Table I. The individual SUBSA hardware items to be stowed are shown in Figures 1 through 5.

3.1.2 Hardware Responsibility. The specific items to be supplied for SUBSA are listed in Table I. The MSG Outfitting Equipment to be supplied by the IM to SUBSA during ISS operations is listed in Table II. Lab Support Equipment that will be used by the investigations during ISS operation is listed in Table III. Microgravity Measurement/Isolation equipment to be used during ISS operations is listed in Table IV.

Table I: SUBSA Supplied Hardware

Nomenclature	Part Number	Dimensions (cm)	Weight (kg)	Qty	Notes
SUBSA THERMAL CHAMBER	5410001-FLT.M01. 00.00-00-00	L:40.5 W: 23.5 H: 15.4 D:	6.1	1	
Process Control Module (PCM)	5410002-FLT.M05. 00.00-00-00	L:28.6 W: 26.7 H: 36.7 D:	8.4	1	Shared with PFMI
DaqPad	5410002-FLT.M06. 00.00-00-00	L:26.7 W: 15.2 H: 4.0 D:	1.2	1	Shared with PFMI Pigtail cable is 76.2cm long
SUBSA SAMPLE BOX ASSEMBLY	5410001-FLT.M02. 00.00-00-00	L: 23.5 W: 40.0 H: 24.8 D:	13.6	1	Keep temp between 4°C to 100°C Contains 10 samples, Two Spares, 1 video Calibration ampoule
COHU Camera	541002-FLT.M04. 00.00-00-00	L:18.57 W: 6.35 H: 8.3 D:	0.7	1	Shared with PFMI (one) Camera + Lens and Pigtail cable attached is 88.9cm long.
SUBSA Camera Stage Assembly	5410001-FLT.M04. 00.00-00-00	L: 15.2 W: 12.7 H: 21.1 D:	1.8	1	
SUBSA Software CD	5410001-FLT.M07. 00.00-00-00	L: 14.3 W: 14.3 H: 1.0 D:	0.04	1	
SUBSA W101 Pwr In	5410001-FLT. M03.04.00-00-00	L: 76.2 H: D: 0.63	0.2	1	
PFMI W305 PCM Video Out	5410002-FLT. M03.03.00-00-00	L: 83.8 H: D: 0.64	0.2	1	Shared with PFMI
PFMI W202 Comm Data	5410002-FLT. M03.02.00-00-00	L: 61.2 H: D: 0.30	0.4	1	Shared with PFMI
SUBSA W301 PCM Video In	5410001-FLT. M03.03.00-00-00	L: 88.9 H: D: 0.64	0.2	1	

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Table I: SUBSA Supplied Hardware (Cont.)

Nomenclature	Part Number	Dimensions (cm)	Weight (kg)	Qty	Notes
SUBSA W102	5410001-FLT.	L: 129.5	0.4	1	
PCM Pwr Out	M03.02.00-00-00	H: D: 0.64			
SUBSA W201	5410001-FLT.M03.	L: 124.5	0.32	1	
Exp Data	01.00-00-00	H: D: 0.64			
Micro Drive Assy, PCMCIA	SEZ33112992 Rev A	L:10.2 W: 5.4 H:0.56 D:	0.016	2	For archival of PFMI & SUBSA science data. (MSG provided)
SUBSA TAPE CASE (1,2)	96M53035	L: 29.0 W: 24.0 H: 10.0 D:	1.4	2	Each contains 20 8mm tapes (MSG provided)
SUBSA Clean-up Kit	5410001-FLT.M07. 02.00-00-00	L: 15.2 W: 15.2 H: 15.2 D:	2.3	1	
Total		0.084 m ³ (2.97 ft ³) H/W	38.7 kg (85.3 lbs)	18	
Control		0.140 m ³	37 kg (81.5 lbs)		Need 1 double MLE (0.112m ³) & ½ MLE (0.028 m ³)

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Table II: MSG Supplied Outfitting Equipment

Nomenclature	Description	Qty	Notes
MLC	Laptop Computer, HD, CD and Floppy	1	
MSG- W201 RS232 cable	RS232Cable to MSG J706	1	
MSG-W203 E-NET External cable	Ethernet Cable to MSG J46	1	
MSG-W202 1553B cable	1553B Cable to MSG Support Panel A&B	2	
MSG-W206 Parallel Port cable	Parallel cable	1	

Table II: MSG Supplied Outfitting Equipment (Cont.)

Nomenclature	Description	Qty	Notes
MSG-W101 28Vdc Pwr Supply cable	MSG 28 Volt to 28V Power Brick	1	
MSG-W102 Pwr Cable	MSG 28 Volt Power Brick to MLC	1	
2" Data Feedthrough	2" feedthrough for WV	1	
MSG Blank Glove Ring Assembly	6" Glove Port Plug	1	
Video Monitor	Sony	2	Includes cable
MSG Spotlight		1	Includes cable
MSG Microphone Footswitch		1	Includes cable
MSG Video Touch Pad		1	Includes cable
MSG Gooseneck		1	
MSG Tissues		1 box	
MLC 28Vdc PWR SUPPLY		1	MLC OPS
MSG Soft Stowage Bag		As required	
MSG Video Multipurpose Arm		2	
MSG Threaded Fastener Accessory Bag		As required	
MSG Velcro Cable Ties		As required	
MSG W301 Video Extension cable		1	
MLC Multipurpose Mount		1	
MLC Multipurpose Arm		1	

Table II: MSG Supplied Outfitting Equipment (Cont.)

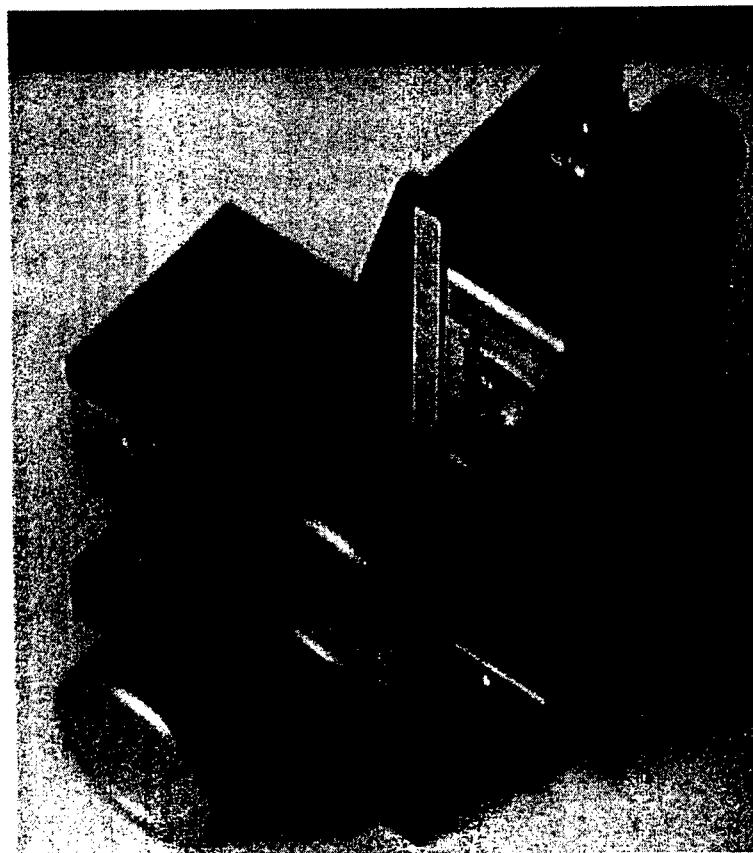
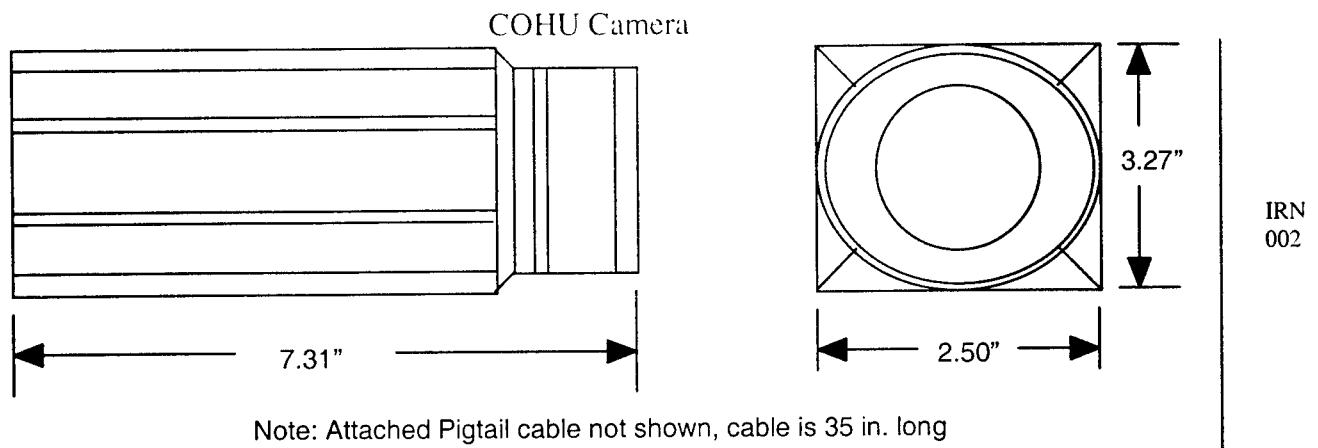
Nomenclature	Description	Qty	Notes
MLC 1553B PC Card		1	
MLC E-NET PC Card		1	
MSG 100mm Bungee Cord		As required	

Table III: Lab Support Equipment

Nomenclature	Description	Qty	Notes
35mm camera		1	Purpose: PR photos of hardware setup and installation.
Video Camera		1	Purpose: PR photos of hardware setup and installation.

Table IV: Microgravity Measurement Equipment

Nomenclature	Description	Qty	Notes
SAMS-II Electronic Enclosure (EE)		1	
SAMS-II Sensor Enclosure (SE)		1	
SAMS-II RTS Cable		1	Between EE and SE
MSG W105 SAMS Pwr cable		1	MSG Provided
MSG SAMS 2 Data cable		1	MSG Provided
MSG SAMS EE Interface Plate		1	MSG Provided
MSG SAMS SE Interface Plate		1	MSG Provided



Stowage dimensions Camera Stage Assembly = 8.3" x 6.0" x 5.0"

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Figure 1: SUBSA COHU Camera and Camera Stage Assembly

July 31, 2001

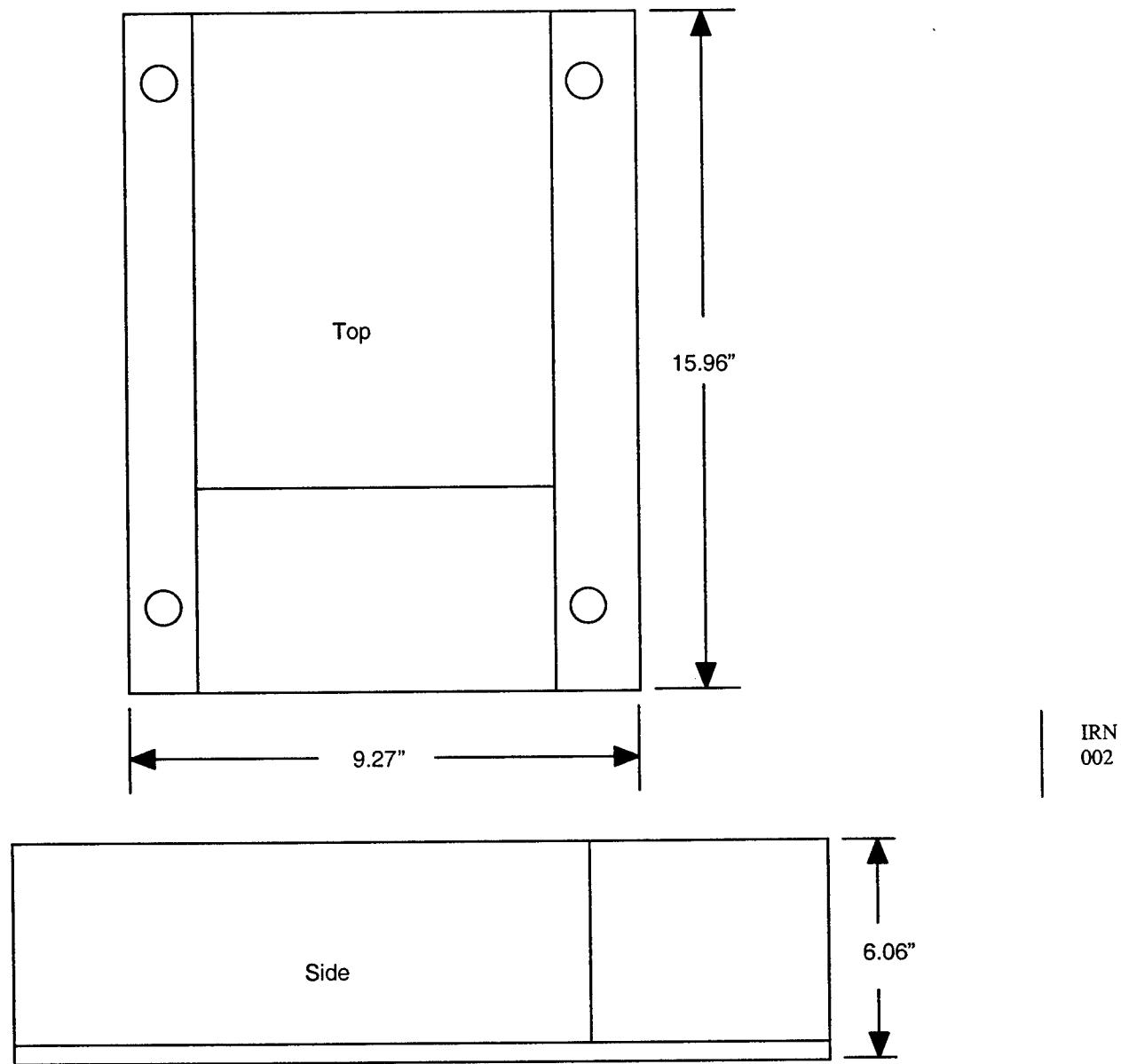
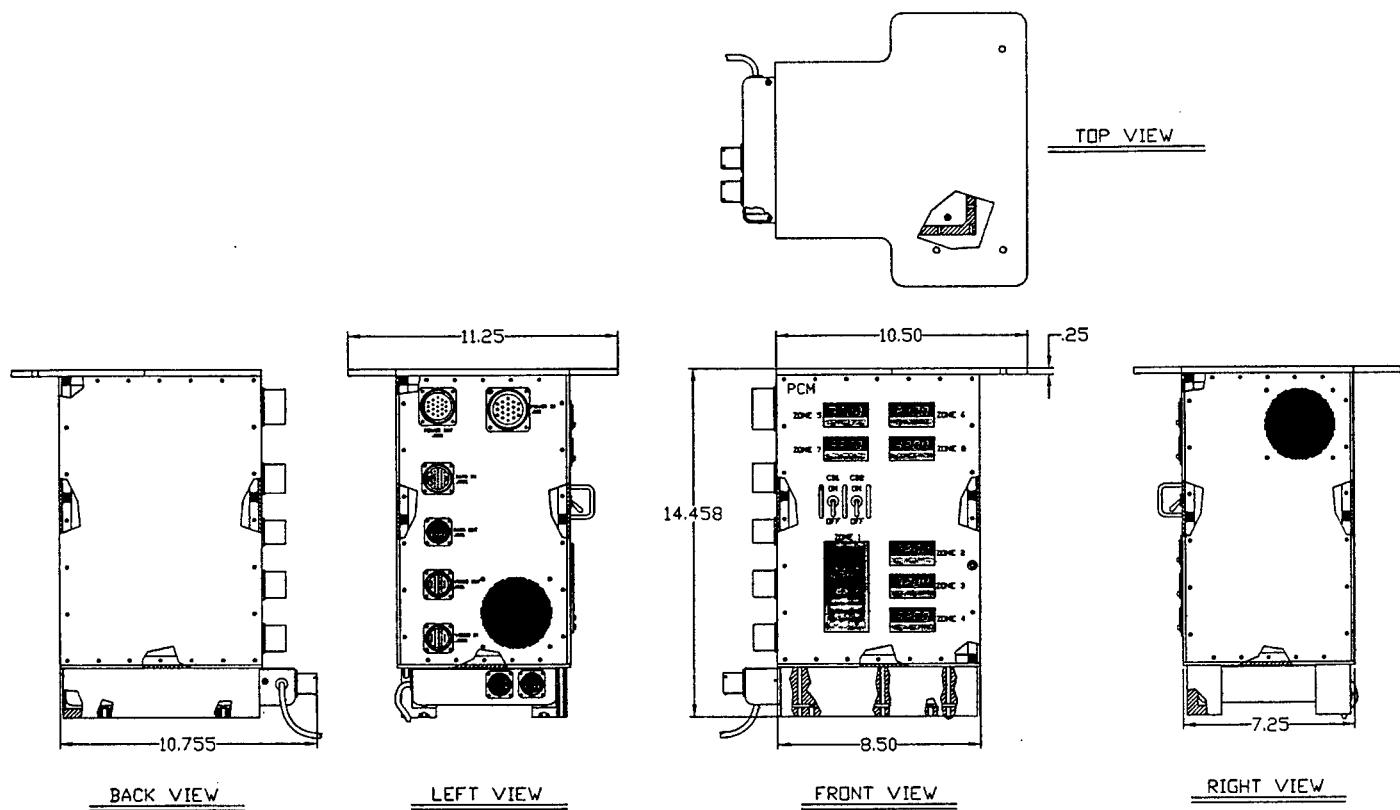
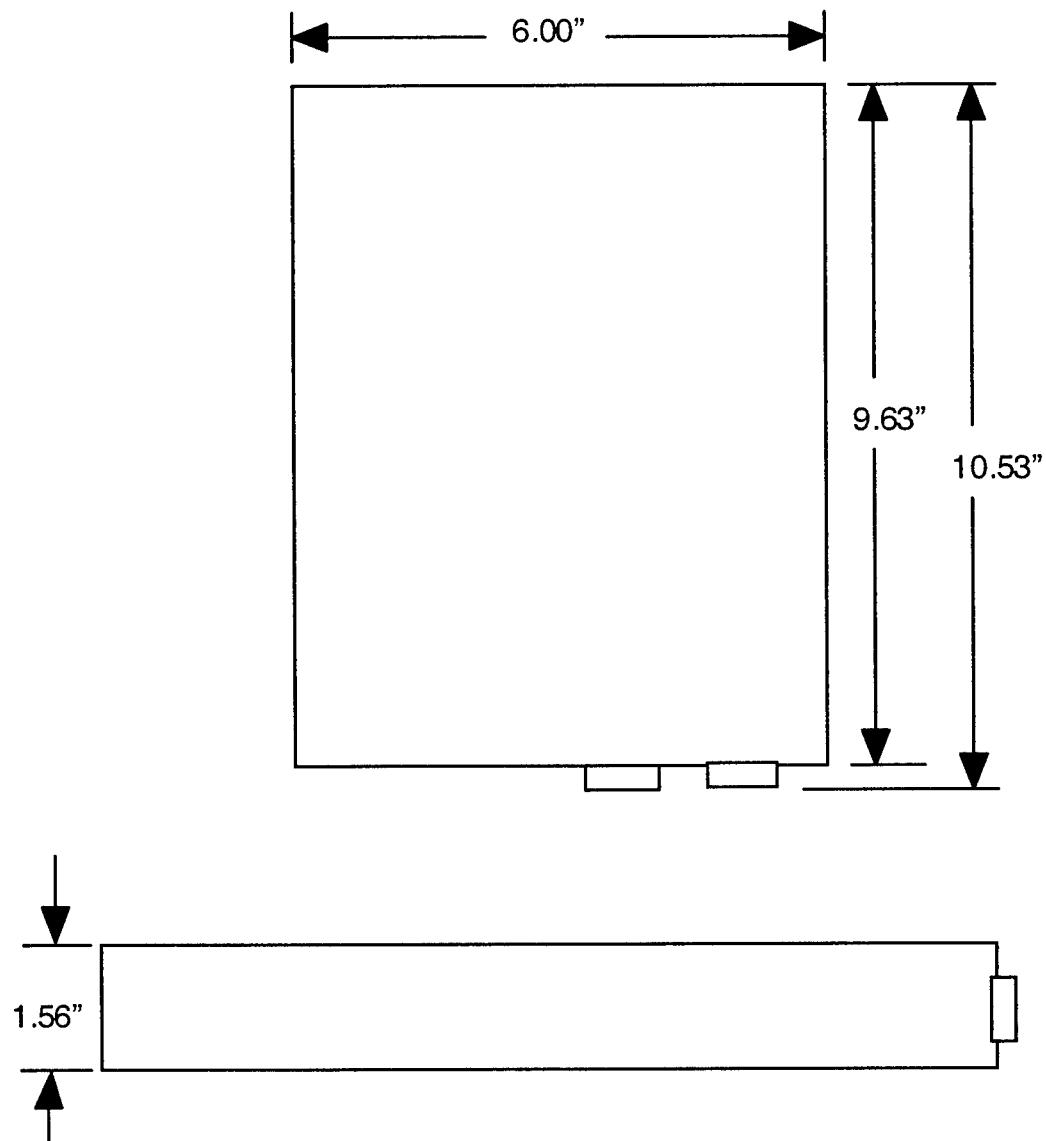


Figure 2: SUBSA Thermal Chamber



Note: (dimensions in inches)

Figure 3: SUBSA PCM



Note: Attached Pigtail cable not shown, cable is 30 in. long

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Figure 4: SUBSA DaqPad

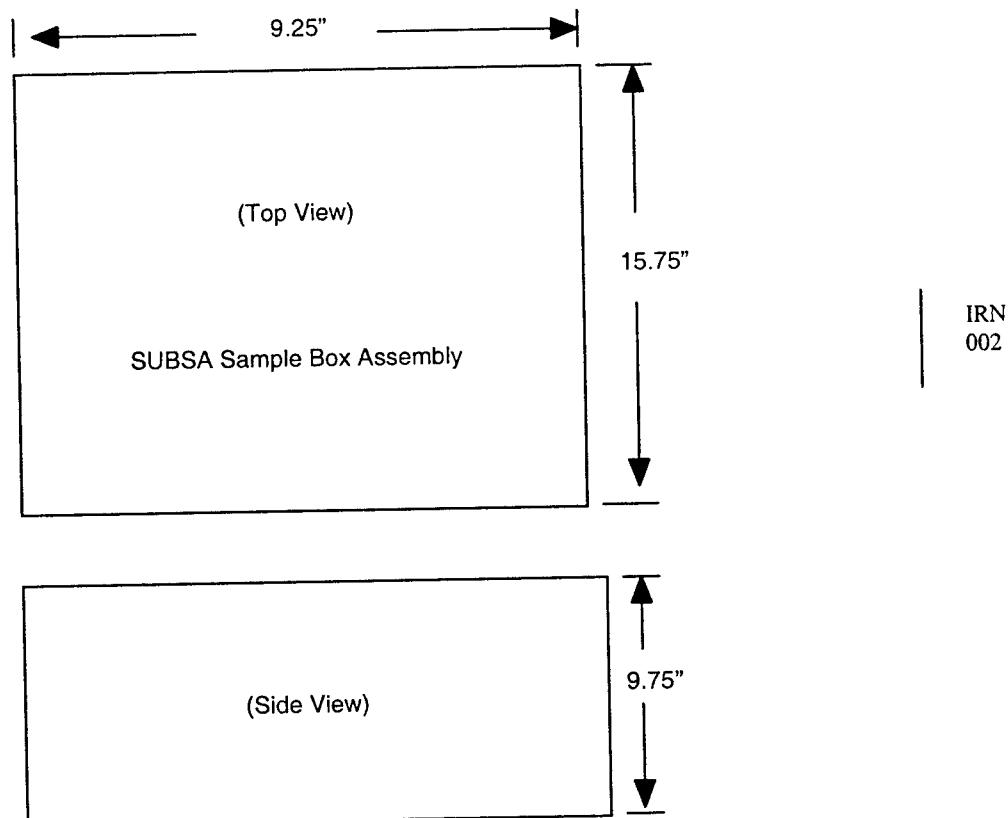


Figure 5: SUBSA Sample Container

3.1.3 Structural/Mechanical Interface. This section identifies and defines the structural/mechanical interfaces between SUBSA and the MSG facility.

3.1.3.1 SUBSA. The PCM will be mounted in the upper right corner of the WV, and the DaqPad will be mounted to the bottom of the PCM. The SUBSA Thermal Chamber will mount to the MSG coldplate using four captive threaded fasteners integrated onto the mounting plate. The SAMS II will be located inside the WV. Figure 6 shows the SUBSA investigation mounting provisions and the location of the hardware in the MSG work volume being used during on-orbit operations. Specific hardware mounting will be documented in the crew procedures.

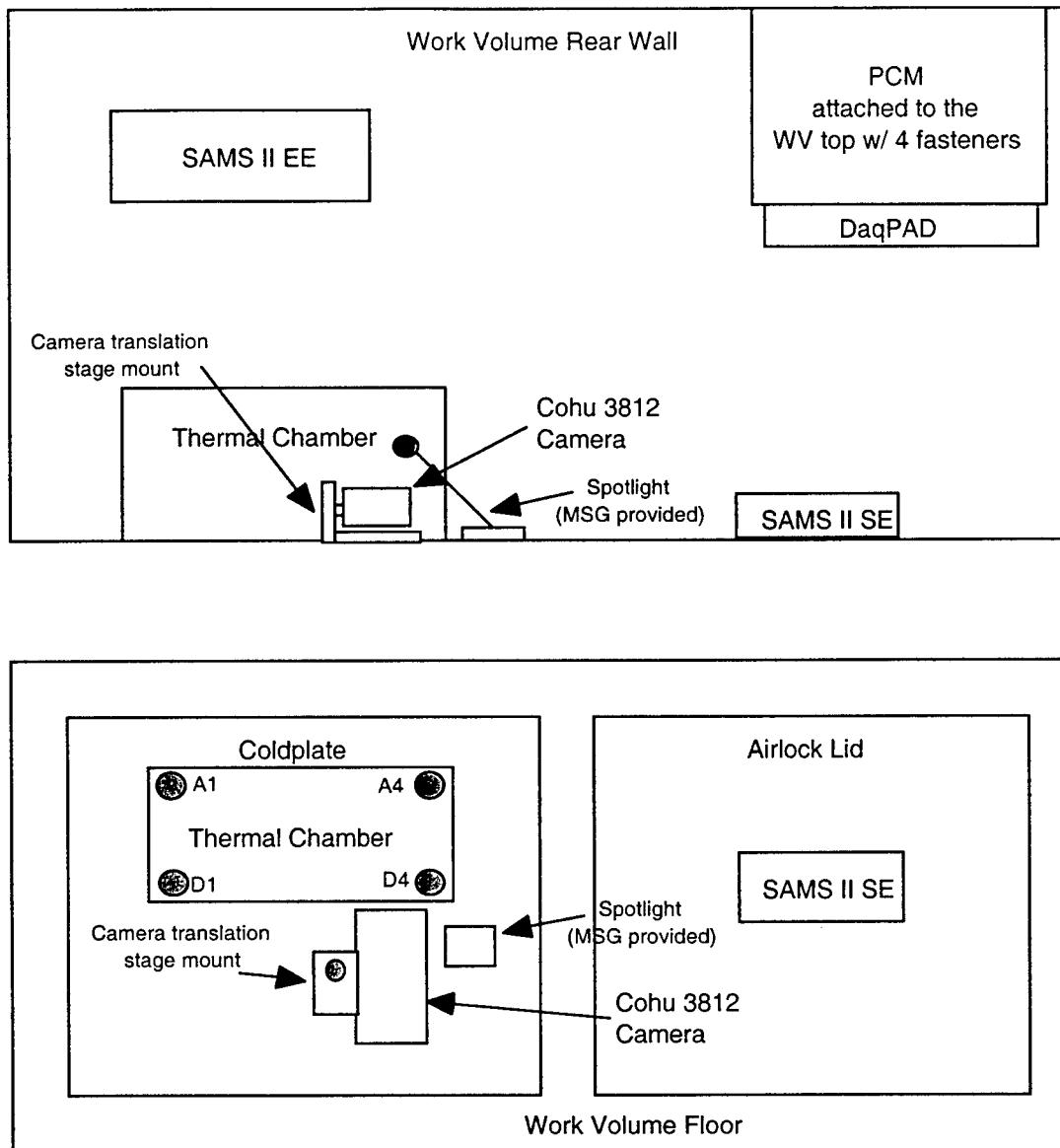


Figure 6: SUBSA Mounting Provisions

3.2 Electrical Interfaces. This section identifies and defines the electrical power interfaces between SUBSA and the MSG facility. A block diagram of the SUBSA electrical interfaces is shown in Figure 7.

3.2.1 Electrical Power Interfaces. The SUBSA investigation interfaces with power conforming to the quality specified in sections 3.2.1 and 3.2.2 of the MSG IIRD MSFC-RMQT-2888. The SUBSA investigation hardware will interface to the MSG primary and secondary power interfaces shown in Tables V and VI.

3.2.2 Cabling Interfaces. The size of all wiring between the investigation and the MSG power source outlets shall be compatible with the rating of the power source circuit protection device and shall conform to the guidelines specified in sections 3.2.2.5 and 3.2.3.1 of the MSG IIRD MSFC-RMQT-2888.

3.2.3 Grounding/Isolation. Grounding and Isolation of the investigation hardware connected to the power source outlets will be in accordance with section 3.2.4.1 of the MSG IIRD MSFC-RMQT-2888.

3.2.4 Bonding. Bonding of the investigation to the MSG will be in accordance with section 3.2.4.2 of the MSG IIRD MSFC-RMQT-2888.

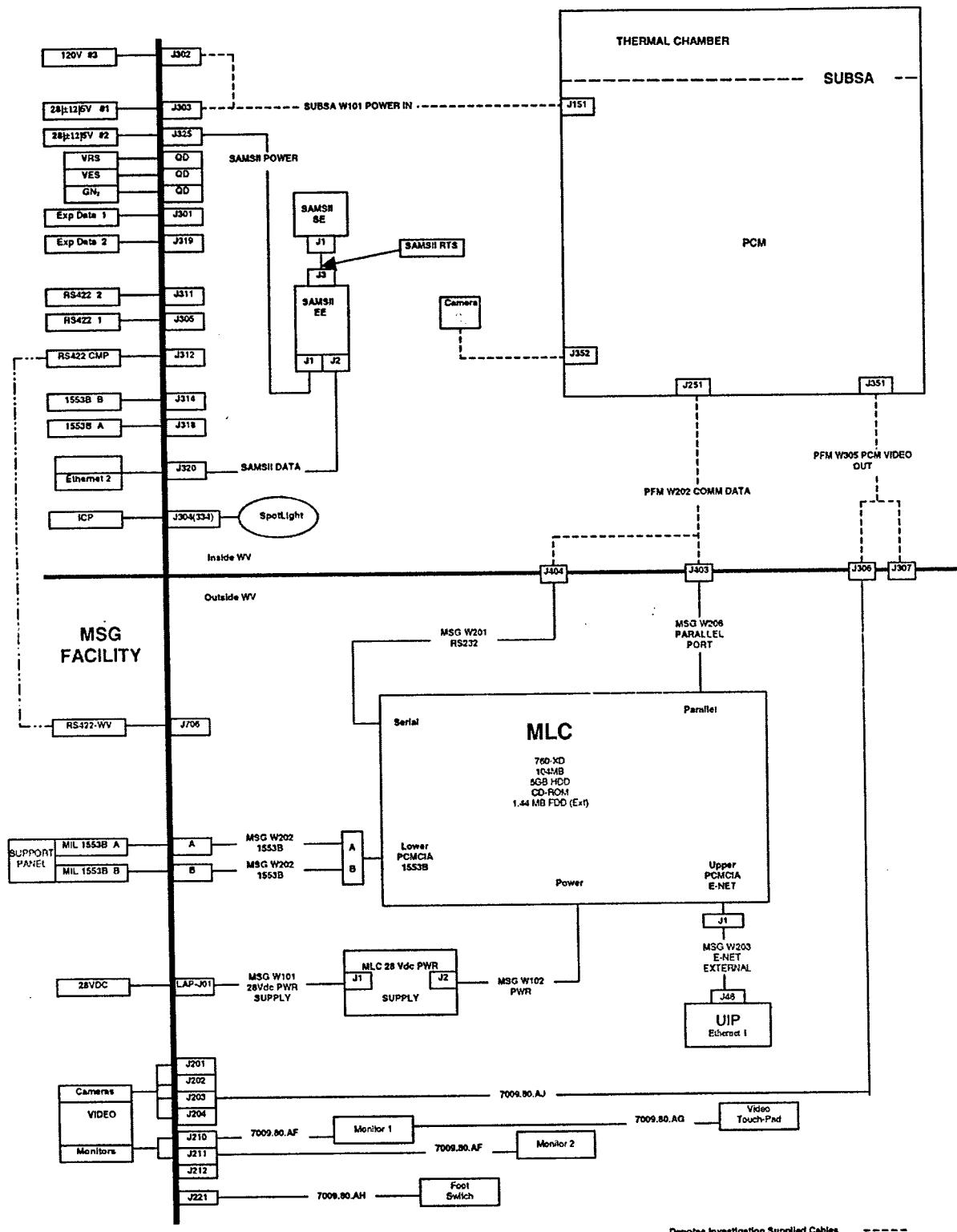


Figure 7: SUBSA Electrical/Signal Block Diagram

Table V: SUBSA to MSG Primary Power Interface Pin Functions

SUBSA Connector Type: MS27467T17F6PA Connector Marking: MSG P302			Mating Connector Type: MS27656P17F6SA Connector Marking: MSG J302			
Pin No.	Pin Gage AWG	Function	Volt Level	Load	Signal Type	Destination
A	12	+120VDC Primary Power	120V \pm 4	8.3A	PWR	MSG/J302
B	12	RTN for 120VDC Primary Power				MSG/J302
C	12	Overall Shield				MSG/J302
D	12	INHIBIT J302				MSG/J302
E	12	RTN for INHIBIT J302				MSG/J302
F	12	Chassis J302				MSG/J302

Note: Contacts D and E shall be bridged inside the investigation circuitry to assure proper operation of the inhibit.

Table VI: SUBSA to MSG Secondary Power Interface Pin Functions

SUBSA Connector Type: MS27467T21F11P Connector Marking: MSG P303			Mating Connector Type: MS27656P21F11S Connector Marking: MSG J303			
Pin No.	Pin Gage AWG	Function	Volt Level	Load	Signal Type	Destination
A	12	+28V Power Exp. Sec.	28V \pm 1	7A	PWR	MSG/J303
B	12	RTN Power Exp. Sec.				MSG/J303
C	12	+12V Power Exp. Sec.	+12V \pm 1	2A	PWR	MSG/J303
D	12	-12V Power Exp. Sec.				Not connected
E	12	RTN 12V Power Exp. Sec.				MSG/J303
F	12	+5V Power Exp. Sec.	5V +.2	4A	PWR	Not connected
G	12	RTN 5V Power Exp. Sec.				Not connected
H	12	INHIBIT J303				MSG/J303
J	12	Shield				MSG/J303
K	12	RTN J303				MSG/J303
L	12	Chassis J303				MSG/J303

Note: Contacts H and K shall be bridged inside the investigation circuitry to assure proper operation of the inhibit.

3.2.5 Power Resource Allocation. Table VII provides a listing of the power allocated to SUBSA for ISS operations. A power profile for SUBSA is shown in Figure 8.

Table VII: SUBSA Power Allocation (Watts)

Item	Off Peak (1)	Peak (2)
SUBSA	275 W	325 W
SAMS II	10 W	10 W

Notes:

(1) Off Peak- Normal operating power.
(2) Peak - The maximum level required.

**SUBSA Investigation Power Draw as a Function of Time
(Includes Thermal Chamber, DaqPad, PCM, & Camera)**

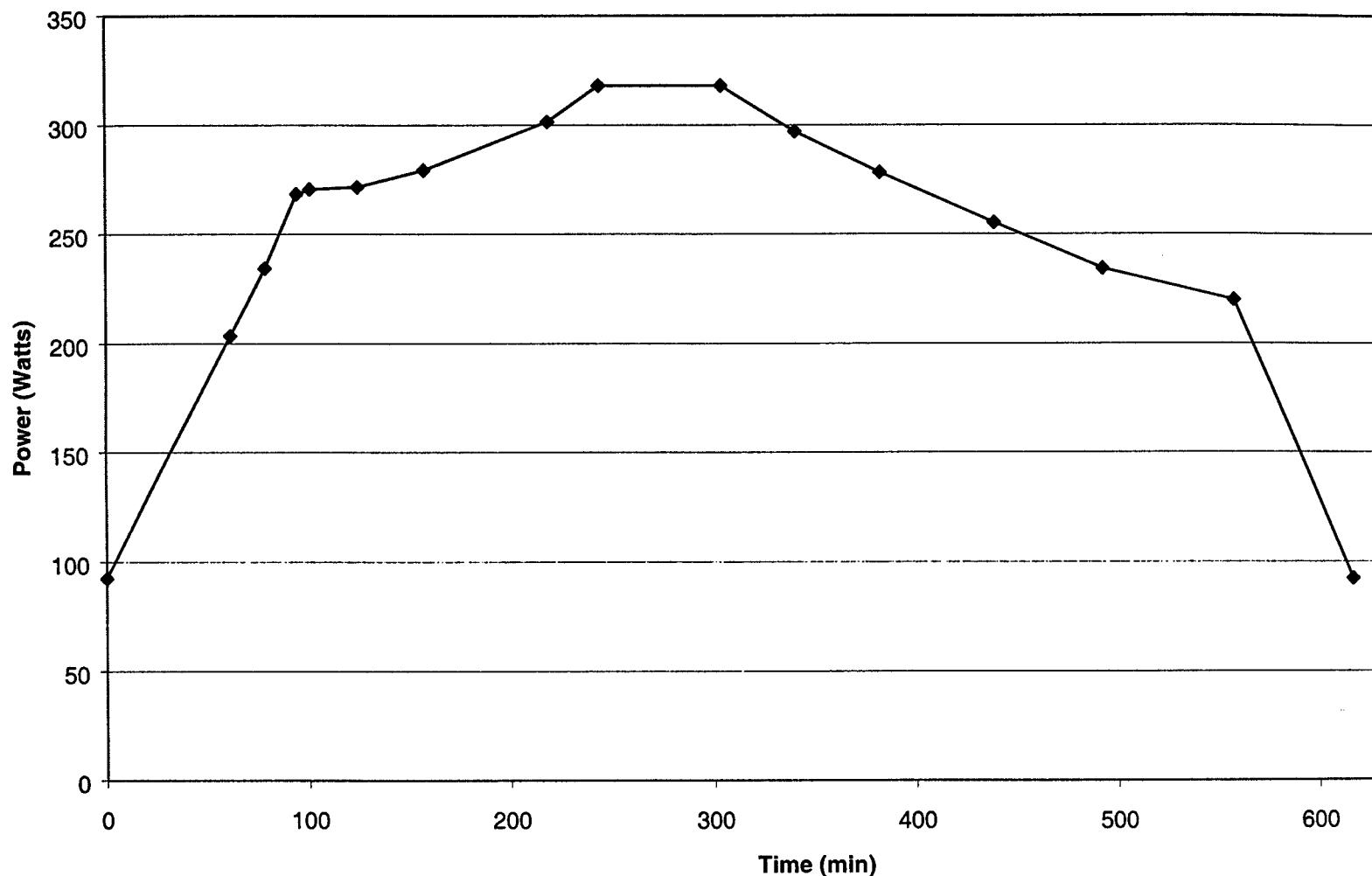


Figure 8: SUBSA Power Profile

3.3 C&DH Interfaces. This section identifies and defines the Command & Data Handling (C&DH) System interfaces between SUBSA and the MSG facility. A block diagram of the SUBSA investigation's signal interfaces is shown in Figure 7.

The SUBSA investigation's C&DH interfaces shall conform to the quality specified in section 3.3 of the MSG IIRD MSFC-RMQT-2888. The SUBSA investigation will interface with the C&DH using the PFMI cables that interface to the MSG feedthrough and video J306 connector as shown in Tables VIII and IX.

SUBSA will use the MLC for data gathering and control, and a COHU camera for capturing the sample image. The DaqPad receives the sample temperature data from the thermocouples and transfers the data to the PCM. The data, time and other status data is overlaid on the sample video images by the PCM and sent to the MSG video recorders. The video signal will be downlinked to the ground and recorded simultaneously. The sample data will be archived on the MLC and downlinked after each run via the Ethernet. SUBSA setpoints can be changed from the MLC or remotely commanded from the ground via the RS-232 interface. SUBSA will provide Labview 6i application software to operate on the MLC.

3.3.1 Data Downlink Requirements.

SUBSA will send the MLC Health and Status data at a rate of 32 Bytes/second. This Health and Status data will be included in the MSG facility Health and Status data and downlinked via the MIL-STD-1553 interface. SUBSA requires post-run data dumps via the Ethernet of the SUBSA science data. The estimated file size of SUBSA data to be downlinked is 1.27 MB, this is assuming an 11 hour run. SUBSA requires downlink of real-time video for sample observation, when available from ISS.

3.3.2 Uplink Requirements.

SUBSA requires an uplink of 9.6 kBytes/sec to change setpoints in their application software on the MLC.

3.3.3 Post Mission Data Requirements.

The following post mission data shall be supplied to PFMI.

- 8mm science tapes
- 35mm photos

- 1G Optical disk with science data
- SAMS acceleration data per Interface Control and Agreement Document (ICAD)

Table VIII: SUBSA to MSG Signal Cable Pin Functions

SUBSA Connector Type: MS27467T9F35P Connector Marking: MSG P404			Mating Connector Type: MS27656P9F35S Connector Marking: MSG J404			
Pin No.	Pin Gage AWG	Function (SUBSA Pin Functions)	Volt Level	Load	Signal Type	Destination
1	20	RX+ (To MLC RS232 PIN 2)	±15VDC	6 ma	RS-232	MSG/J404
2	20	RX- (NOT USED)	±15VDC	6 ma	RS-232	MSG//J404
3	20	RX Shield (To MLC RS232 Ground PIN 5)	0VDC	0 ma	RS-232	MSG//J404
4	20	TX+ (To MLC RS232 Receive PIN 3)				Not Connected
5	20	TX- (NOT USED)				Not Connected
6	20	TX Shield				Not Connected

Table VIII: SUBSA to MSG Signal Cable Pin Functions (Cont.)

SUBSA Connector Type: NB6E18-32PN Connector Marking: PFM P403			Mating Connector Type: NB5H18-32PSN Connector Marking: MSG J403			
Pin No.	Pin Gage AWG	MSG Pin Functions (SUBSA Pin Functions)	Volt Level	Load	Signal Type	Destination
1	20	Strobe (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
2	20	Bit 0 (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
3	20	Bit 1(SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
4	20	Bit 2 (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
5	20	Bit 3 (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
6	20	Bit 4 (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
7	20	Bit 5 (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
8	20	Bit 6 (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403

Table VIII: SUBSA to MSG Signal Cable Pin Functions (Cont.)

9	20	Bit 7 (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
10	20	Ack (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
11	20	Bsy (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
12	20	Paper End (ERROR)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
13	20	Select In (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
14	20	Autofeed (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
15	20	Error (FAULT)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
16	20	Init (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
17	20	Select (SAME)	-0.5 to +5.5VDC	14 ma	IEEE1284	MSG J403
18	20	Ground (not used)				
19	20	Ground (SAME)	0VDC	0 ma	IEEE1284	MSG J403
20-25	20	Grounds (20 – 25 not used)				

Table IX: SUBSA to MSG Video Connector Pin Functions

SUBSA Connector Type: FGG-2B-319-CLCD62 Connector Marking: P306 Video Feedthrough			Mating Connector Type: SGJ-2B-319-CLL-PV (LEMO) Connector Marking: MSG J306			
Pin No.	Pin Gage AWG	Function (SUBSA Function)	Volt Level	Load	Signal Type	Destination
1	22	RTN (same)				MSG /J306
2	22	+ 12V In (Same)	+12V	TBD	PWR	MSG/J306
3	22	Not Connected				
4	TSP	RTN Comp. Video				Not Connected
5	TSP	Comp. Video				Not Connected
6	TSP	RTN Y (same)				MSG /J306
7	TSP	Y Out (same)		75 Ohm	Video	MSG /J306
8	TSP	RTN C				Not Connected
9	TSP	C Out				Not Connected
10	TSP	RTN Sync				Not Connected
11	TSP	Sync In				Not Connected
12	24	RTN				Not Connected

Table IX: SUBSA to MSG Video Connector Pin Functions (Cont.)

13	24	Not Connected				Not Connected
14	24	SD In				Not Connected
15	24	SD Out				Not Connected
16-19	24	Not Connected				

3.4 Thermal Control Interface Allocations. This section identifies and defines the thermal/heat dissipation requirements between SUBSA and the MSG facility. The interfaces and resources requested and allocated to SUBSA are shown in Tables X and XI.

The thermal interfaces contained in this section are limited to flight phases. These include launch, ascent, on orbit, and descent, continuing through post landing cargo bay purge and stabilization.

3.4.1 Ascent/Descent. SUBSA does not require resources during ascent/descent.

3.4.2 On-Orbit Thermal Characteristics. The heat generated by SUBSA is shown in Table XI, and gives a break down of the heat dissipation for each investigation hardware item.

3.5. Vacuum System Requirement.

3.5.1 Vacuum Exhaust System. N/A

3.5.2 Vacuum Resource System. N/A

3.6. Pressurized Gas Requirement.

3.6.1 GN2 Requirement. N/A

3.6.2 Pressurized Gas Bottles N/A

Table X: Environmental Control Requirements

Investigation	Air	Coldplate	Vacuum Vent	Vacuum Resource	GN2
SUBSA	X	X	N/A	N/A	N/A

Table XI: SUBSA Thermal Accommodations

Investigation Hardware Item	Nominal H/W heat dissipation (W)		Coldplate		Air Loop		Cabin Air	
	Nom	Max	Nom	Max	Nom	Max	Nom	Max
Thermal Chamber	210	250	134	161	76	89	N/A	N/A
Process Controller	60	60	N/A	N/A	60	60	N/A	N/A
DaqPad	4	4	N/A	N/A	4	4	N/A	N/A
Camera	3.5	3.5	N/A	N/A	3.5	3.5	N/A	N/A
SAMS II	10	10	N/A	N/A	10	10	N/A	N/A
MLC	45	45	N/A	N/A	N/A	N/A	45	45
Monitor	38.4	38.4	N/A	N/A	N/A	N/A	38.4	38.4
28V Powerbrick	2	2	N/A	N/A	N/A	N/A	2	2
Spotlight	10	10	N/A	N/A	10*	10*	N/A	N/A
ICP	5	5	N/A	N/A	5*	5*	N/A	N/A
Total	387.9	427.9	134	161	168.5	181.5	85.4	85.4

* Engineering estimate, test data not available yet.

3.7 Special Environment. This section is used to identify any special environmental requires the investigations have during on-orbit or launch phases of the increment.

3.7.1 Vibration. The SUBSA investigation requires vibration/acceleration measurements using SAMS II and MAMS-MESA data.

3.7.2 Stowage. The SUBSA investigation samples require that stowage temperatures be kept between 4 °C and 100 °C.

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3.8 KSC Requirements. There are two categories of KSC inputs required for payloads which will be flown and operated on the ISS. These two categories are:

- 1) KSC support requirements (offline)
- 2) KSC technical requirements (online)

The following Tables identify the requirements SUBSA will need during KSC processing.

Table XII: Investigation Support Requirements

Req. No.	Reqmt	Specifications	Qty	Comments
Offline Processing				
SUBSA		Final Check prior to turnover		
Online Processing				
SUBSA		Online testing with the facility		
User Room Area				
SUBSA		500 square feet (shared with PFM)		
		Work Table (3) Storage cabinet (1)		
GSE, Special Test Equipment (Investigation supplied)				
SUBSA		Water Chiller, MSG coldplate emulator, sample ampoule assembly, Power supplies (2), Test equipment (multimeters), Data Logger, Laptop (2), Printer, Cables, Toolkit, Test stand		
Electrical Power				
SUBSA		110V outlet	8	
Stowage Requirements (at KSC)				
SUBSA		N/A		
Other				
		Cooling Water Supply (tap water)		
		Hand Cart	1	
		Nitrogen	1K-bottle	99.999% purity
		Dry Air	1K-bottle	99.999% purity

Table XIII: Equipment Support Requirements

Req. No.	Reqmt	Specifications	Qty	Comments
KSC Administrative Support				
SUBSA		Phone, Internet Access	2	
		Desk (2) chairs (6) file cabinet book shelf (1)		
KSC GSE and Special Test Equipment				
		N/A		
Other				

Table XIV: Chemical Support Requirements

Req. No.	Reqmt	Specifications	Qty	Comments
Chemicals				
SUBSA		Alcohol	½ gal	
Fluids				
SUBSA		DI water	5 gal.	

Table XV: Reusable and Expendable Supply Support Requirements

Req. No.	Reqmt	Specifications	Qty	Comments
Reusable and Expendable Supplies				
SUBSA		Lint free cloths	1 box	
		Gloves	1 box	
		Clean room clothes	1 box	
Other				

Table XVI: General Services Support Requirements

Req. No.	Reqmt	Specifications	Qty	Comments
Communications (including OIS-D)				
		N/A		
Equipment and Container Storage				
		N/A		
Hazardous Disposal, Storage, and Handling				
		Alcohol		
Photographic and Video Support				
		Yes		
Technical Support				
		N/A		
Transportation / Shipping				
		Shipment of containers back to investigations	TBD	
Other				

Table XVII: KSC Technical Requirements

Requirement Subjects	Required?
Handling/Orientation Requirements	N/A
Orbiter Middeck Late Installation/Servicing Between L-72 hrs and L-24 hrs	N/A
Orbiter Middeck Late Installation/Servicing within a Specific Time Between L-24 hrs and L-18.5 hrs	N/A
Orbiter Middeck Early Runway Destow	N/A
Orbiter Middeck OPF/MDD Destow within R+48 hours	N/A
Sample Loading	L-88 hours
Sample Mixing	N/A
Launch Delay (Refurbishment/Replacement)	N/A

4.0 VERIFICATION

4.1 Purpose. The purpose of this Interface Control Document (ICD) is to define and control the design of interfaces between the SUBSA hardware and the MSG facility based on the requirements in the Investigation Interface Requirements Document (IIRD), MSFC-RQMT-2888. The Investigation Developer and the Investigation Integration Team must mutually disposition (Applicable or Not Applicable) each IIRD paragraph and record that disposition in the Verification Applicability Matrix, Appendix B.

4.2 Verification Applicability Matrix. The SUBSA Verification Applicability Matrix, Table XVIII lists the Microgravity Science Glovebox Interface and Safety Verification Requirements for SUBSA with associated verification methods. The Applicability (A) or (N/A) and a schedule for data submittal of each hardware element will be developed on a case-by-case basis.

Definitions of Column Headings for Verification Requirements

Requirement Number	Identifies verification requirements by number and the item status is tracked by using this number.
Requirement Title	Identifies the requirement.
Safety Related	Identifies those items required to satisfy a Hazard control.
MSG IIRD Paragraph	Defines the interface being used and the verification activity required for use of that interface.
Verification Method(s)	Defines the method(s) required to perform the verification function.
Hardware Item(s)	Defines each hardware element (i.e. Exp. Control Box, Exp. Sample Container, etc.) and its applicability to the requirement.
Due Date	Defines the date that the verification package is due to the Investigation Integration Team.
Remarks	Defines the Verification Data Sheet number or if it is a PSRP/Safety requirement.

The Investigator Verification Applicability Matrix, identifies items relevant to each verification requirement and hardware element. The items identified are: the method(s) of verification, the relevant Verification Data Sheet, if safety related and whether the item is applicable (A) or not applicable (N/A). Acceptable methods of verification are denoted

by: Analysis (“An”), Test (“Test”), Inspection (“Ins”), and Demonstration (Dem). Types of certification are Certification of Compliance (COC) (denoted by “c”) and Data Certification (“d”). For a more detailed description of the methods, certifications and safety verification, see Section 4.0 and 5.0 of the MSG IIRD, MSFC-RQMT-2888.

MSFC-ICD-3086A

June 4, 2001

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MSFC-ICD-3086A
Appendix A
June 4, 2001

APPENDIX A

ACRONYMS

Appendix A

A	Applicable
C&DH	Command & Data Handling System
COC	Certification of Compliance
DaqPad	Data Acquisition Pad
DCP	Dynamics Characterization Payload
GI	Glovebox Investigator
ICAD	Interface Control and Agreement Document
ICD	Interface Control Document
ID	Investigation Developer
IIRD	Investigator Interface Requirements Document
IIT	Investigation Integration Team
IM	Integration Manager
InSb	Indium-Antimonide
ISS	International Space Station
Kg	Kilogram
KSC	Kennedy Space center
MAMS	Microgravity Acceleration Measurement System
MESA	Miniature Electrostatic Accelerometer
MLC	MSG Laptop Computer
MLE	Middeck Locker Equivalent
MSFC	Marshall Space Flight Center
MSG	Microgravity Science Glovebox
N/A	Not Applicable
NRV	No Verification Required
OIS	Operational Intercommunication System
OPF	Orbiter Processing Facility
OPS	Operations
PCM	Process Control Module
PFMI	Toward Understanding Pore Formation and Mobility During Controlled Directional Solidification in a Microgravity Environment Investigation
PSRP	Payload Safety Review Panel
Qty	Quantity
QD	Quick Disconnect
RX	Receive
PWR	Power
RTN	Return
SAMS	Space Acceleration Measurement System
SE	Sensor Enclosure
SUBSA	Solidification Using a Baffle in Sealed Ampoules
TBD	To Be Determined
TX	Transmit

UF2	Utilization Flight Two
V	Volt
Vdc	Voltage Direct Current
VDS	Verification Definition Sheet
VES	Vacuum Exhaust System
VRS	Vacuum Resource System
VCR	Video Cassette Recorder
W	Watt
WV	Work Volume

MSFC-ICD-3086A

Appendix A

June 4, 2001

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MSFC-ICD-3086A
Appendix B
June 4, 2001

Appendix B
SUBSA Verification Matrix

TABLE XVIII SUBSA VERIFICATION MATRIX

MSG IIRD Reqmt. No.	Requirement Statement	Safety	Verif. Method(s)	Thermal Chamber	Cables	PCM	DaqPad	Sample Ampoules	Stowage Boxes	Software	Due Date	Remarks/ IIT VDS #
3.1.1.1.c & d	Loads Requirements		A	A	N/A	A	N/A	A	N/A	N/A	L-8	"d" not applicable ST-001 & ST-002
3.1.1.2.a & b	Additional Requirements		A&T	A	A	A	A	A	A	N/A	L-8	ST-003 & ME-001
3.1.1.3	Attachment Provisions (fit check with facility)		T&I	A	A	A	A	N/A	N/A	N/A	L-20	ME-046
3.1.2.1	Quasi-Steady Requirements		A or T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-20 & L-12	EN-005
3.1.2.2	Vibratory Requirements		A or T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-20 & L-12	EN-005
3.1.2.3	Transient Requirements		A or T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-20 & L-12	EN-005
3.1.3	Stowage (Weight & Volume)		ICD input	A	A	A	A	A	A	N/A	L-8	
3.2.1.a & b	Electrical Power Characteristics (Power Draw)		A & T	A	A	A	A	N/A	N/A	N/A	L-8	EL-006
3.2.1.1	Steady-State Voltage Characteristics		T	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-001
3.2.1.2.1	Ripple Voltage and Noise	Yes	A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-10	EL-002
3.2.1.2.2	Ripple Voltage Spectrum	Yes	A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-10	EL-002
3.2.1.3	Transient Voltages		A or T	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-003
3.2.1.3.1.a & b	Fault Clearing and Protection		A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-004
3.2.1.3.2	Non-Normal Voltage Range		A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	Only applies to 120V EL-005
3.2.2.1.b, c, d	Primary Power Connector		I & D	N/A	A	A	N/A	N/A	N/A	N/A	L-8	EL-007
3.2.2.2.b, c, d	Secondary Power Connector		I & D	N/A	A	A	N/A	N/A	N/A	N/A	L-8	EL-007
3.2.2.3.a	Surge Current		A & T	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-010
3.2.2.4	Reverse Energy/Current		A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-011
3.2.2.5.a & b	Circuit Protection Devices	Yes	A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-012
3.2.2.6	Maximum Ripple Voltage		A & T	N/A	N/A	A	N/A	N/A	N/A	N/A	L-10	EL-015

Legend:

A – Analysis (when in verification method column), A – Applicable (when used in hardware column), D – Demonstrate, I – Inspection, N/A – Not Applicable
 NVR – No verification required, PSRP – Payload Safety Review Panel, T – Test,

TABLE XVIII SUBSA VERIFICATION MATRIX

MSG IIRD Reqmt. No.	Requirement Statement	Safety	Verif. Method(s)	Thermal Chamber	Cables	PCM	DaqPad	Sample Ampoules	Stowage Boxs	Software	Due Date	Remarks/ IIT VDS #
	Emissions											
3.2.2.7	Electrical Load-Stand Alone Stability		A	A	A	A	A	N/A	N/A	L-10	EL-016	
3.2.3.1	Wire Derating	Yes	A	A	A	A	A	N/A	N/A	L-8	EL-017	
3.2.3.2	Loss of Power	Yes	T (PSRP)	A	N/A	A	A	N/A	N/A	L-8	Safety	
3.2.4	Electromagnetic Compatibility	Yes	A & T	A	A	A	A	N/A	N/A	N/A	L-10	EL-020
3.2.4.1.a – e thru 3.2.4.1.2.7	Electrical Grounding/Isolation	Yes	A & T	A	A	A	A	N/A	N/A	N/A	L-10	EL-020 & EL-021
3.2.4.2 thru 3.2.4.2.6.3.2	Electrical Bonding	Yes	T & I & A	A	A	A	A	N/A	N/A	N/A	L-10	EL-020 & EL-022
3.2.4.3.1.2.1.3	Shield Grounding Requirements		T & I & A	A	A	A	A	N/A	N/A	N/A	L-10	EL-021
3.2.4.3.1.2.4	Shields		A & I	N/A	A	N/A	N/A	N/A	N/A	N/A	L-10	EL-021
3.2.4.3.1.2.4.1	Terminations		A & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-10	EL-021
3.2.4.3.1.2.4.3	Grounding of Radio Frequency Circuit Shields		A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-10	EL-021
3.2.4.3.1.2.4.4	Internal Equipment Shields		A	A	A	A	A	N/A	N/A	N/A	L-10	EL-021
3.2.4.3.1.2.4.5	Grounding		A	A	A	A	A	N/A	N/A	N/A	L-10	EL-021
3.2.4.4 thru 3.2.4.4.2.6	Electromagnetic Emission and Susceptibility Requirements	Yes	A & T	A	A	A	A	N/A	N/A	N/A	L-10	EL-020
3.2.4.5	Electrostatic Discharge	Yes	A & T or T & I	A	A	A	A	N/A	N/A	N/A	L-10	EL-024
3.2.4.6	Alternating Current Magnetic Fields	Yes	A or T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-10	EL-020
3.2.4.7	Direct Current Magnetic Fields	Yes	A & T	N/A	N/A	A	N/A	N/A	N/A	N/A	L-10	EL-020 N/A for SUBSA - A & T for PFMI

TABLE XVIII SUBSA VERIFICATION MATRIX

38

MSG IIRD Reqmt. No.	Requirement Statement	Safety	Verif. Method(s)	Thermal Chamber	Cables	PCM	DaqPad	Sample Ampoules	Stowage Boxs	Software	Due Date	Remarks/ IIT VDS #
3.2.5.1	Mating/Demating of powered connectors	Yes	I (PSRP)	A	A	A	N/A	N/A	N/A	N/A	L-8	Safety
3.2.5.2	Safety-Critical Circuits Redundancy	Yes	A (PSRP)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	"Closed with HR approval" Safety
3.2.5.3.a	Power Switches/Controls	Yes	A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-029
3.2.5.3.b	Power Switches/Controls	Yes	A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-029
3.2.5.3.c	Power Switches/Controls	Yes	A	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	EL-029
3.2.5.4.a - g	Ground Fault Circuit Interrupters	Yes	D,A & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	Not Portable No Outlets EL-030
3.3.1.1	Software		Per SSP-52050	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	
3.3.1.1.1	Software Protocol		T	N/A	N/A	N/A	N/A	N/A	N/A	A	L-8	CD-01.
3.3.1.1.2	Byte and Bit Order		I	N/A	N/A	N/A	N/A	N/A	N/A	A	L-8	CD-01
3.3.1.1.3	ESTEC Data Link Format		I	N/A	N/A	N/A	N/A	N/A	N/A	A	L-8	CD-01
3.3.1.1.4	Command Acknowledge & Log Messages		I	N/A	N/A	N/A	N/A	N/A	N/A	A	L-8	CD-02
3.3.1.1.5	Commanding		T	A	A	A	N/A	N/A	N/A	A	L-8	CD-02
3.3.1.1.6	Health and Status		T	A	A	A	A	A	N/A	A	L-8	CD-02
3.3.1.1.7	Caution and Warning		T	A	A	A	A	A	N/A	A	L-8	CD-02
3.3.1.1.8	File Transfer		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	CD-02
3.3.1.1.9	Illegal Commands		T	N/A	N/A	N/A	N/A	N/A	N/A	A	L-8	CD-02
3.3.3.1.b	RS-422 Connector/Pin Assignments		D & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	EL-007
3.3.3.2	RS-422 Signal Characteristics		I & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	CD-01
3.3.3.3	RS-422 Cabling		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	EL-033
3.3.4	I/O Signal Levels & Resolution		A & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	CD-03
3.3.4.1.b	I/O Connector/Pin Assignments		D & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	EL-007

Legend:

A – Analysis (when in verification method column), A – Applicable (when used in hardware column), D – Demonstrate, I – Inspection, N/A – Not Applicable
 NVR – No verification required, PSRP – Payload Safety Review Panel, T – Test,

TABLE XVIII SUBSA VERIFICATION MATRIX

MSG IIRD Reqmt. No.	Requirement Statement	Safety	Verif. Method(s)	Thermal Chamber	Cables	PCM	DaqPad	Sample Ampoules	Stowage Boxs	Software	Due Date	Remarks/ IIT VDS #
3.3.5.1	Ethernet Protocol		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	CD-10
3.3.5.1.1	Investigation Protocol on Ethernet		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	CD-10
3.3.5.1.2	Ethernet Address		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	CD-10
3.3.5.1.3	Ethernet Connectivity		I & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-8	CD-11
3.3.5.1.4	Ethernet Connector/Pin Assignments		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	EL-007
3.3.5.1.5	Ethernet Signal Characteristics		I & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-8	CD-12
3.3.5.1.6	Ethernet Cable Characteristics		D & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-8	CD-12
3.3.5.1.6.1	Insertion Loss		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-8	CD-12
3.3.5.1.6.2	Differential Characteristic Impedance		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-8	CD-12
3.3.5.1.6.3	Medium Time Jitter		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-8	CD-12
3.3.6	MSG Laptop Computer Protocol		T	N/A	N/A	N/A	N/A	N/A	N/A	A	L-8	CD-07
3.3.6.1.1	RS-232C Data Port		I & T	N/A	A	N/A	N/A	N/A	N/A	N/A	L-8	CD-07
3.3.6.1.2	Parallel Port		I & T	N/A	A	N/A	N/A	N/A	N/A	N/A	L-8	CD-07
3.3.7	Video Interface Requirements		T & I, A or T	N/A	A	N/A	N/A	N/A	N/A	N/A	L-9	CD-08
3.4.1.1	WV Air Circulation System		A & T	A	N/A	A	A	N/A	N/A	N/A	L-8 & L-9	FD-002
3.4.1.2.1.a - f	Investigation Coldplate Mounting Requirements		A, T & I	A	N/A	N/A	N/A	N/A	N/A	N/A	L-8 & L-9	FD-003
3.5.1.1.a - e	VES Physical Interface		D & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-014
3.5.1.2.a, b, c	VES Input Pressure Limit		A & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-015
3.5.1.3	VES Input Temperature Limit		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-016

Legend:

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TABLE XVIII SUBSA VERIFICATION MATRIX

MSG IIRD Reqmt. No.	Requirement Statement	Safety	Verif. Method(s)	Thermal Chamber	Cables	PCM	DaqPad	Sample Ampoules	Storage Boxes	Software	Due Date	Remarks/ IIT VDS #
3.5.1.4	VES Input Dewpoint Limit		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-017
3.5.1.5.a - d	VES Acceptable Exhaust Gases		A or T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-20	FD-018
3.5.1.5.2.a - e	VES External Contamination Control		A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-20	FD-019
3.5.1.5.3	VES Incompatible Gases		A & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-020
3.5.2.1.a - e	VRS Physical Interface		D & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-021
3.5.2.2.a, b, c	VRS Input Pressure Limit		A & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-022
3.5.2.3	VRS Through-Put Limit		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-023
3.6.1.1.a	Nitrogen Physical Interface		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-027
3.6.1.1.b	Nitrogen Leakage		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-027
3.6.1.2	Nitrogen Flow Control		T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-024
3.6.1.3	Nitrogen Interface MDP		A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-12 & L-15	FD-025
3.6.1.4	Nitrogen Interface Temperature		A or T or A & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-026
3.6.2	Pressurized Gas Bottles	Yes	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-028
3.7.1.1	Pressure	Yes	A or T (PSRP)	A	A	A	A	A	A	N/A	L-8	Closed when hazard report app.
3.7.1.2	Temperature	Yes	A or T (PSRP)	A	A	A	A	A	A	N/A	L-8	Closed when hazard report app.
3.7.1.3	Humidity		A	A	A	A	A	A	A	N/A	L-8	EN-001
3.7.2.3.1.a - d	Spotlight Interface Requirements		D & I & T	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	EL-037
3.7.3.a, c, d, e	WV Environment		A or T or D	A	A	A	A	A	A	N/A	L-8	EN-007
3.7.4.1	Active Air Exchange		A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	EN-002
3.7.4.2	Oxygen Consumption		A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	EN-003
3.7.4.3	Chemical Releases	Yes	A T & I (PSRP)	N/A	N/A	N/A	N/A	A	N/A	N/A	L-8	Closed when hazard report app.
3.7.4.4	Cabin Air Cooling		A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	EN-002

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TABLE XVIII SUBSA VERIFICATION MATRIX

41

MSG IIRD Reqmt. No.	Requirement Statement	Safety	Verif. Method(s)	Thermal Chamber	Cables	PCM	DaqPad	Sample Ampoules	Stowage Boxs	Software	Due Date	Remarks/ IIT VDS #
3.7.5.1	Investigation Contained or Generated Ionizing Radiation	Yes	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	Safety
3.8	Fire Protection Interface Requirements	Yes	A (PSRP)	A	N/A	A	A	N/A	N/A	N/A	L-8	Closed when hazard report app.
3.8.1.1.a - d	Investigation Fire Detection	Yes	T (PSRP)	N/A	N/A	N/A	N/A	N/A	N/A	A	L-8	Closed when hazard report app. Or CD-02 if applicable
3.8.1.2.a, b, c	Investigation Fire Suppression	Yes	A & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-055
3.9.1	Materials and Parts Use and Selection	Yes	A & I (PSRP)	A	A	A	A	A	A	N/A	L-8	Closed when hazard report app.
3.9.1.1	Commercial Parts	Yes	A & I (PSRP)	A	A	A	A	A	A	N/A	L-8	Closed when hazard report app.
3.9.1.2.a - f	Additional Material Requirements		A, I & T	A	A	A	A	A	A	N/A	L-8 & L-12 & L-20	FD-019, MP-003 (for f), MP-004
3.9.2	Cleanliness		I	A	A	A	A	A	A	N/A	L-8	MP-002
3.10.1.a, b, c	Strength Requirements		A or D	A	A	A	A	A	A	N/A	L-8	ST-005
3.10.2.1.1	Closures or Covers		I	A	A	A	A	A	A	N/A	L-8	ME-007
3.10.2.1.2.a	Built-In Control	Yes	I	N/A	N/A	N/A	N/A	A	N/A	N/A	L-8	ME-008
3.10.2.1.2.b	Built-In Control	Yes	A or D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-008
3.10.2.1.3	One-handed Operation		D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-009
3.10.2.2.1	Continuous/Incidental Contact-High Temperature	Yes	A (PSRP)	A	N/A	A	A	A	N/A	N/A	L-8	Closed when hazard report app.
3.10.2.2.2	Continuous/Incidental Contact-Low Temperature	Yes	A (PSRP)	A	N/A	A	A	A	N/A	N/A	L-8	Closed when hazard report app.
3.10.2.2.3.a	Acoustic Requirements	Yes	T	N/A	N/A	A	N/A	N/A	N/A	N/A	L-10	EN-006
3.10.2.2.3.b	Intermittent Noise Limits	Yes	T	N/A	N/A	A	N/A	N/A	N/A	N/A	L-10	EN-006
3.10.2.2.4	Lighting Design		D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-043

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TABLE XVIII SUBSA VERIFICATION MATRIX

MSG IIRD Reqmt. No.	Requirement Statement	Safety	Verif. Method(s)	Thermal Chamber	Cables	PCM	DaqPad	Sample Ampoules	Storage Boxes	Software	Due Date	Remarks/ IIT VDS #
3.10.3.1	Equipment Mounting		A or D	A	A	A	A	A	N/A	L-8	ME-011	
3.10.3.2	Unique Tools		A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-016	
3.10.3.3	Connectors (Header)											
3.10.3.3.1	One-Handed Operation		A or D	A	A	A	A	N/A	N/A	L-8	ME-017	
3.10.3.3.2	Connector Accessibility		A or D	A	A	A	A	N/A	N/A	L-8	ME-018	
3.10.3.3.3	Connector Ease of Disconnect		A or D	A	A	A	A	A	N/A	N/A	L-8	ME-017
3.10.3.3.4	Connector Self Locking		A or D	A	A	A	A	A	N/A	N/A	L-8	ME-017
3.10.3.3.5	Connector Arrangement		I	A	A	A	A	A	N/A	N/A	L-8	ME-018
3.10.3.3.6	Connector Arc Containment	Yes	A	A	A	A	A	A	N/A	N/A	L-8	
3.10.3.3.7	Connector Protection	Yes	A	A	A	A	A	A	N/A	N/A	L-8	ME-019
3.10.3.3.8	Connector Shape		A	A	A	A	A	A	N/A	N/A	L-8	ME-019
3.10.3.3.9	Fluid and Gas Line Connectors	Yes	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	FD-001
3.10.3.3.10	Connector Coding		I	A	A	A	A	A	N/A	N/A	L-8	ME-020
3.10.3.3.11	Connector Pin Identification		I	A	A	A	A	A	N/A	N/A	L-8	EL-007
3.10.3.3.12	Connector Orientation		A or D	A	A	A	A	A	N/A	N/A	L-8	ME-020
3.10.3.3.13	Alignment Marks or Guide Pins		I	A	A	A	A	A	N/A	N/A	L-8	ME-020
3.10.3.4	Fasteners (Header)											
3.10.3.4.1	Non-Threaded Fasteners Status Indication		D or I	A	N/A	N/A	N/A	A	N/A	N/A	L-8	ME-023
3.10.3.4.2	Mounting Bolt/Fastener Spacing		I	A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-024
3.10.3.4.3	Multiple Fasteners		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-025
3.10.3.4.4	Captive Fasteners		A	A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-026
3.10.3.4.5	Quick Release Fasteners		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-026
3.10.3.4.6	Threaded Fasteners		I	A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-026
3.10.3.4.7	Over Center Latches		I	N/A	N/A	N/A	N/A	N/A	A	N/A	L-8	ME-027
3.10.3.4.8	Winghead Fasteners		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-026

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TABLE XVIII SUBSA VERIFICATION MATRIX

MSG IIRD Reqmt. No.	Requirement Statement	Safety	Verif. Method(s)	Thermal Chamber	Cables	PCM	DaqPad	Sample Ampoules	Storage Boxs	Software	Due Date	Remarks/ IIT VDS #
3.10.3.4.9	Fastener Head Type		I	A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-028
3.10.3.4.10	One-Handed Actuation		A or D	A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-029
3.10.3.4.12	Fastener Access Holes		I	A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-024
3.10.4	Controls and Displays (Header)											
3.10.4.1	Controls Spacing Design Requirements		I	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-030
3.10.4.2.a, b, c	Actuation Protective Methods		I	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-031
3.10.4.3	Controls Noninterference		I	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-030
3.10.4.4	Controls Barrier Guards		I	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-030
3.10.4.5	Recessed Switch Protection		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-031
3.10.4.6	Controls Position Indication		I	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-032
3.10.4.7	Hidden Controls		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-031
3.10.4.8	Hand Controllers		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-031
3.10.4.9.a - e	Valve Controls		I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-033
3.10.4.10	Toggle Switches		I	N/A	N/A	A	N/A	N/A	N/A	N/A	L-8	ME-034
3.10.5.1.a, b, c	Stowage Drawer Contents Restraints		A & I	N/A	N/A	N/A	N/A	N/A	A	N/A	L-8	ME-036
3.10.5.2.a & b	Stowage and Equipment Drawers/Trays		I	N/A	N/A	N/A	N/A	N/A	A	N/A	L-8	ME-027
3.10.5.3	Captive Parts		I	N/A	N/A	N/A	N/A	A	N/A	N/A	L-8	Only Items that can be removed from assemblies ME-036
3.10.5.4	Handles and Restraints		I or D	N/A	N/A	N/A	N/A	N/A	A	N/A	L-8	ME-037
3.10.5.5	Handle Location/Front Access		I	N/A	N/A	N/A	N/A	N/A	A	N/A	L-8	ME-037
3.10.5.6	Handle Dimensions		D & I	N/A	N/A	N/A	N/A	N/A	A	N/A	L-8	ME-037
3.10.7	Identification Labeling		I	A	A	A	A	A	A	N/A	L-8	ME-057

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3.10.8.1.a	Crew Safety Electrical Hazards	Yes	NRV	A	A	A	N/A	N/A	N/A	N/A	L-8	EL-041
3.10.8.1.b	Crew Safety Electrical Hazards	Yes	A &/or T	A	A	A	N/A	N/A	N/A	N/A	L-8	EL-041
3.10.8.1.c	Crew Safety Electrical Hazards	Yes	A &/or T	A	A	A	N/A	N/A	N/A	N/A	L-8	EL-041
3.10.8.1.d	Crew Safety Electrical Hazards	Yes	A &/or T	A	A	A	N/A	N/A	N/A	N/A	L-8	EL-041
3.10.8.1.e	Crew Safety Electrical Hazards	Yes	A &/or T	A	A	A	N/A	N/A	N/A	N/A	L-8	EL-041
3.10.8.2	Mismatched	Yes	A, I & D	A	A	A	A	A	N/A	N/A	L-8	ME-019
3.10.8.3.1	Device Accessibility		I	N/A	N/A	A	A	N/A	N/A	N/A	L-8	EL-013
3.10.8.3.2	Extractor – Type Fuse Holder		D	N/A	N/A	A	A	N/A	N/A	N/A	L-8	EL-013
3.10.8.3.3	Overload Protection Location		I	N/A	N/A	A	A	N/A	N/A	N/A	L-8	EL-013
3.10.8.3.4	Overload Protection Identification		I	N/A	N/A	A	A	N/A	N/A	N/A	L-8	EL-013
3.10.8.3.5	Automatic Restart Protection		D	A	N/A	A	A	N/A	N/A	N/A	L-8	EL-013
3.10.8.4	Sharp Edges and Corners Protection	Yes	I (PSRP)	A	A	A	A	A	A	N/A	L-8	Closed when hazard report app.
3.10.8.4.1	Holes	Yes	A & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-007
3.10.8.4.2	Latches	Yes	I	N/A	N/A	N/A	N/A	N/A	A	N/A	L-8	ME-027
3.10.8.4.3	Screws and Bolts	Yes	A & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-026
3.10.8.4.4	Securing Pins	Yes	I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-053
3.10.8.4.5	Levers, Cranks, Hooks, and Controls	Yes	A & I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-053
3.10.8.4.6	Burrs	Yes	I	A	A	A	A	A	A	N/A	L-8	ME-053
3.10.8.4.7	Lockwire	Yes	A or I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ST-009
3.10.9	Payload In-Flight Maintenance		A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	L-8	ME-003

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3.10.11	Egress	Yes	(PSRP)	A	N/A	A	A	A	N/A	N/A	L-8	Closed when hazard report app.
3.11	Safety	Yes	(PSRP)	A	A	A	A	A	A	A	L-8	Closed when hazard reports app.
C.3.5.11	Bar Coding		I	A	A	A	A	A	A	A	L-8	ME-041

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PACKAGE NO. 9538R

DOCUMENTATION RELEASE LIST
GEORGE C. MARSHALL SPACE FLIGHT CENTERMSFC CODE IDENT 14981
ISSUE DATE JUN 20 2001

PAGE 1

C H	DOCUMENT NUMBER	DRL DSH	DRL REV	TITLE	CCBD NO.	PCN	PC	EFFECTIVITY
*	MSFC-ICD-3086	202 -		MSFC-ICD-3086, MSB ICD FOR (SUBSA)	GB3-02-0011	GB00210	GB	61
CHG NO.	CHG REV	CHG NOTICE	RESPONSIBLE ENGINEER	RESPONSIBLE ORGANIZATION	ACTION DATE	DESCRIPTION		
* 1 A	IRN001		E. BLACKWOOD	SD46	06/20/01	REVISION A SUPERSEDES THE BASELINE RELEASE AND INCORPORATES IRN001.		

CHECKER

DON HAMILTON
06/11/01

(FINAL)

PACKAGE NO. 9585R

DOCUMENTATION RELEASE LIST
GEORGE C. MARSHALL SPACE FLIGHT CENTERMSFC CODE IDENT 14981
ISSUE DATE AUG 15 2001

PAGE 1

C	DOCUMENT	DRL	DRL	TITLE	CCBD NO.	PCN	PC	EFFECTIVITY
H	NUMBER	DSH	REV					
*	MSFC-ICD-3086	203	-	MSFC-ICD-3086, MSB ICD FOR (SUBSA)	GB3-02-0014	GB00235	GB	61
<hr/>								
CHG	CHG	CHG	RESPONSIBLE	RESPONSIBLE	ACTION	DESCRIPTION		
NO.	REV	NOTICE	ENGINEER	ORGANIZATION	DATE			
1	A	IRN001	E. BLACKWOOD	SD46	06/20/01	REVISION A SUPERSEDES THE BASELINE RELEASE AND INCORPORATES IRN001.		
*	2	A	IRN002	DOUG MARTIN	SD46	08/15/01	APPROVAL OF IRN002 CORRECTION TO SUBSA ICD, PART NO.'S, DIMENSIONS, HEAT DISSIPATION	

CHECKER

D. HAMILTON
08/14/01

(FINAL)

DOCUMENT INPUT RECORD

I. TO BE COMPLETED UPON SUBMITTAL OF DATA

1. APPROVED PROJECT: <i>MSFC</i>	2. DOCUMENT/ DRAWING NO.: <i>MSFC- ICD-3086 109889528R</i>	3. CONTROL NUMBER: <i>109889528R</i>	4. DOCUMENT RELEASE DATE:	5. SUBMITTAL DATE:
6. DOCUMENT/DRAWING TITLE: <i>MSFC ICD for S1B6A</i>			7. REPORT TYPE: <i>DOC.</i>	
8. CONTRACT NO./PERFORMING ACTIVITY: <i>SD46</i>		9. DRD NUMBER: <i>71A</i>	10. DPD / DRL / IDRD NUMBER: <i>71A</i>	
11. DISPOSITION AUTHORITY (official records only): <i>SD46</i>		12. SUBMITTAL AUTHORITY: <i>SD46</i>	13. RELEASING AUTHORITY: <i>SD46</i>	
14. SPECIAL INSTRUCTIONS: <i>None</i>				
15. CONTRACTOR/SUBMITTING ORGANIZATION, ADDRESS AND PHONE NUMBER: <i>MSFC</i>			16. ORIGINATING NASA CENTER: <i>MSFC</i>	
17. OFFICE OF PRIMARY RESPONSIBILITY: <i>SD46</i>				
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